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CR-133135

CENTER FOR RESEARCH, INC.
UNIVERSITY OF KANSAS

# ERTS DETAILED IMAGE INTERPRETATION REPORT

CRINC DIIR No. 2265-2
Date Prepared 8 Feb 73

Subject:

Grid Measurement of Small Water Bodies

Subject Geographic Coordinates $38^{\circ}$ 10N/$98^{\circ}$35W

NASA Test Site No. NA

NASA Image Descriptors:
Water, Marsh, Mensuration

Report Summary:

A technique for measuring the area of small water bodies is presented. The method involves the overlaying of 1 mm grids onto a 3.16X enlargement of the MSS-7 (9.5) image and counting the number of water-filled squares. Initial tests reveal an accuracy for area measurement on the order of ± 10% for water bodies

(E73-10768) GRID MANAGEMENT OF SMALL WATER BODIES (Kansas Univ. Center for Research, Inc.) 5 p HC $3.00 CSCL 08H

N73-27244

Unclas
G3/13 00768

Imagery References

| CRINC Image No. | NASA Image ID Block | Subject Image Coordinates X | Y | Cloud Cover | Image Quality |
|---|---|---|---|---|---|
| MP00142 | E-1023-16451-6 (9.5) | 102 | 120 | 10% | Poor |
| MP00295 | E-1095-16454-7 (9.5) | 100 | 160 | 0% | Good |
| MP00568 | E-1131-16460-7 (9.5) | 104 | 164 | 0% | Good |

Map References:

USGS NJ 14-5, scale 1:250,000

Digital Data Used Yes ___ No x

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## REPORT

In semi-arid regions the number of surface water bodies and the area of surface water varies from season to season and year to year. The number of surficial water bodies at any given time is an important data element in decisions relating to these semi-arid regions. For example, the number of water bodies may provide the wildlife manager with an index to available water sources and an indirect assessment of wildlife conditions. It could inform the regional long range crop assessment groups with an estimation of degree of aridity or drought in the region. Therefore, we have developed a simple method to count water bodies and measure the area of surficial water bodies from the ERTS imagery.

The infrared bands of the MSS, particularly band 7, provide an almost binary decision of water/non-water. This image feature is attributable to the extremely low relative reflectivity of water in these wavelengths. The primary sources of confusion are the following:

1) shadows of clouds
2) standing water in irrigated field (AIR 2264-2)
3) areas of terrain shadowing
4) areas where soil moisture exceeds field capacity, especially immediately after local heavy rains
5) areas of innundated vegetation, for example marshlands.

Human interpreters by shape and context can resolve the 1, 2 and 3 of the above confusion sources. Interpreters may, to a degree, be hampered by sources 4 and 5.

## Method

The following technique was developed to collect number and area data for the water bodies:

1) The MSS-7, 9.5 inch positive transparency was enlarged 3.16X.

2) The area to be studied, in this case Quivera National Wildlife Refuge, was overlayed with a 1X1 mm grid (each grid cell represented a ground area of ≈ 10 hectares (ha) ).

3) The number of grid cells containing water were plotted into 10X10 graph paper.

4) This graph paper map could then be analyzed to determine the numbers and area of the water bodies.

This method was used by five different image interpreters to analyze the Quivera National Wildlife Refuge, Stafford County, Kansas. The interpreters graphed water bodies in the refuge from 3 different images (acquired 15 August, 26 October, and 1 December 1972). These 15 interpretations constituted a data set for analysis of variations in the results of the application of this technique. This analysis took two forms: (1) comparison of the variation in number of the water bodies and (2) comparison of area of wastes. The sequence of images provided inputs relative to the effect of variations in image quality, overall water area, and effect of the presence of large marshes.

The graph interpretation of the water bodies for one interpreter are shown in Figure 1. The pattern of the water bodies representing both the numeric and aerial increase is clearly evident. This pattern was repeated in its general form by each interpreter. However, for specific dates, both the number and area of the water bodies varied from interpreter to interpreter (Table 1).

Both the detectability and the relative error of area were a function of water body size (Figure 2). Review of this figure leads to the conclusion that errors in size are essentially normally distributed.

The interpreter concensus points to a minimum water body detection size of $\approx 5$ ha (.5 m x 1.0 m at 1:316,000). At this size error in water area is induced by the grid procedure of filling a grid if any water is detectable. It was also observed by the interpreters that as water bodies increased in size, their detectability increased, but the ability to delimit their boundaries decreased.

This boundary detection problem results from the changing nature of the water - non-water interface at different shoreline positions. At low water levels, vegetation areas surround the water body. As the water level rises, the water invades the vegetation and generally enters a more complex topography. The covering vegetation tends to partially obscure the water and add a component to the reflection. Since healthy vegetation is a strong reflector in band 7, the vegetation-water reflection tends to be intermediate (mid-gray tone on the image). The topographic complexities introduce a spatial pattern of variation in the presence of water and land at the order of scale of the resolution cell. This variation results in averaging the tone in some resolution cells and juxtaposing light and dark resolution cells. The human interpreter integrates these variously toned cells as a medium gray. The water boundary decision then becomes a subjective judgment of the human interpreter as to what medium gray tone actually represents water.

6

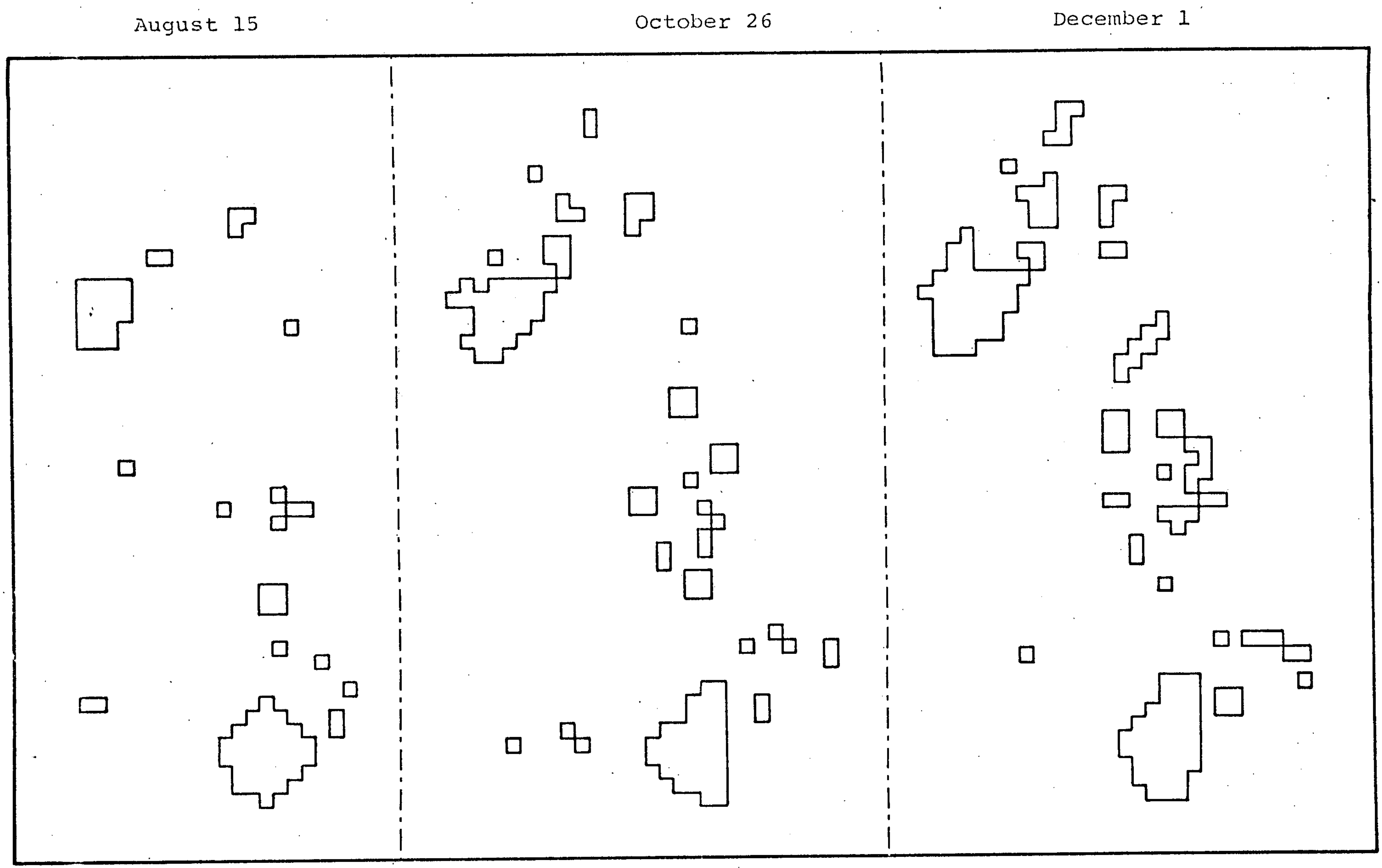


Figure 1. Graphical interpretation of areas of water bodies in Quivera National Wildlife Refuge on three dates. These graphs were prepared by the same interpreter and therefore constitute an internally comparable set.

Figure 2. Distribution of water body size estimated by five interpreters, against the concensus water body size.